NEI 97-06 Proposed Steam Generator Generic License Change Package

Document 1:
staff Presentation

Introductory Remarks

ACRS Materials and Metallurgy Subcommittee

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Background

- Regulatory requirements for SG inspection/repair are prescriptive and out of date
  - Requirements not focused on key objective of ensuring tube integrity for entire period between inservice inspections
  - Meeting these requirements does not, in and of itself, ensure tube integrity is being maintained
- Staff initiative for a revised regulatory framework has evolved over time; staff has previously met with ACRS SC to discuss initiative
  - Rulemaking - 1996 and 1997
  - Generic Letter and Regulatory Guide - 1997
  - Consideration of industry's NEI 97-06 initiative - 1999
  - Review of NEI SG Generic Change Package (GCP) - 2001

NEI SG Generic Change Package (GCP)

- Initially submitted February 4, 2000
  - Revised submittal dated December 11, 2000
- Staff did not initiate review until January 2001
  - due to followup activities relating to IP-2 SG tube failure on February 15, 2000
- Staff initiative to revise regulatory framework through review of NEI 97-06 GCP is part of the NRC Steam Generator Action Plan

Inspection Interval Issue

- At the NRC SG Workshop in February 2001, industry representatives discussed draft revisions to the EPRI SG examination guidelines to permit inspection intervals for SGs with Alloy 600 TT or Alloy 690 TT tubing well beyond current EPRI guidelines and regulatory requirements:

- Staff is concerned that certain EPRI guidelines are not sufficiently well developed to ensure that extended inspection intervals will be implemented so as to ensure that:

  - tube integrity performance criteria will continue to be met

  - tubing conditions not meeting the performance criteria will be promptly detected

Presentations to Follow

- Jim Riley from NEI will summarize industry steam generator program, NEI 97-06, upon which NRC revised SG regulatory framework is based

- Emmett Murphy will then discuss in some detail staff's concerns with GCP that are related to inspection intervals and resolution path staff is pursuing

NEI Steam Generator Generic Change Package (SG GCP)
-Outstanding Issues

ACRS Materials and Metallurgy Subcommittee

November 29, 2001

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Background/Purpose

- September 25, 2001 Briefing of ACRS Materials and Metallurgy Subcommittee
  - Overview discussion of the NEI SG GCP, including background
  - NRC review status including outstanding issues.
- Today's briefing is intended to provide Committee members with additional details of the outstanding issues, proposed resolutions, and an update of the current status and plans.

Current Requirements

Inspect a specified sample of SG tubes at specified intervals, and plug tubes containing indications which exceed specified limit.

- Frequency: 24 calendar months (typically one fuel cycle), or
  40 calendar months if degradation activity is minimal
- Sample Size: 3 to 100%, depending on level of degradation
- Plugging Limit: 40% TW (typ)

Inspection methods are subject to ASME Code requirements. However, improved inspection performance through the years has been largely driven by technology improvements and improved industry practice in accordance with EPRI examination guidelines.

Safety Considerations

- Available evidence from operating experience is that steam generator tubes generally operate with acceptable safety margins, consistent with the licensing basis.
  - Exceptions do occur, but appear to be relatively isolated occurrences.
  - Exceptions include, but not limited to the eight SGTR events in the US to date.
- Risk studies (e.g., NUREG-0844 and NUREG-1570) indicate that risk from SG related causes is within acceptable levels.
  - Ongoing work in this area as part of the SG Action Plan
- Room for improvement from past performance.

Safety Considerations (Continued)

The acceptable safety record to date reflects:

- Current TS requirements; notably including the 24 month inspection interval requirement for plants with active degradation effectively limiting inspection intervals to one fuel cycle.

- Industry actions in excess of minimum regulatory requirements.

Industry Guidelines

- EPRI Secondary Water Chemistry Guidelines
- EPRI Steam Generator Examination Guidelines
- EPRI Primary to Secondary Leakage Monitoring Guidelines

- EPRI Steam Generator In Situ Pressure Test Guidelines

- EPRI Steam Generator Integrity Assessment Guidelines

- NEI 97-06, "Steam Generator Program Guidelines"

Industry guidelines reflect consideration of:

- operating experience/industry and NRC studies/new technology
- NRC generic communications
- DG-1074

Industry Proposed Admin TS: "Steam Generator Program"

An **SG Program** shall be established and implemented to ensure SG tube integrity performance criteria are maintained.

- Condition monitoring assessments of as-found tube condition vs the performance criteria shall be performed at each SG inspection outage. Requirements for condition monitoring are defined in the **SG Program**.

- Changes to performance criteria are subject to NRC review and approval.

- Changes to tube repair criteria and repair methods are subject to NRC review and approval.

Tube Integrity Performance Criteria

Structural Criteria:

- Maintain factor of three against burst under normal full power operating conditions.
- Maintain factor of 1.4 against burst for postulated accident conditions.

Accident-Induced Leakage Criteria:

- Accident leakage shall not exceed that assumed in licensing basis accident analysis.
- Accident leakage shall not exceed [1 gpm, except as approved by NRC].

SG Program

- Details of the SG program will be located outside of tech specs
- Licensee's will commit to developing the SG Program in accordance with NEI 97-06, which references detailed EPRI guidelines.
- NEI 97-06 provides general guidance for a performance based, programmatic strategy for ensuring SG tube integrity.

Condition Monitoring

10 CFR 50, Appendix B, Criterion 16: Measures shall be established to assure that conditions adverse to quality are promptly detected and corrected.

Condition monitoring programs must be capable of meeting this requirement.

Failure to fully satisfy the performance criteria represents a tolerable condition, provided such condition is promptly detected and corrected.

EPRI SG Examination Guidelines, Revision 5 (1997):

- Prescriptive criteria for inspection frequency and sampling
  - Inspection sample: 20 to 100%
  - Inspect each refueling outage (12 to 22 EFPM)
  - Inspect every second refueling, if no "active degradation"
  - Inspect 100% of active tubes by each 60 EFPM
  - Per NEI 97-06, scheduled inspection intervals must be supported by operational assessment (OA)
- Performance based criteria for inspection frequency and sampling
  - Inspection intervals and sample size shall be such as to ensure performance criteria are maintained, as supported by OA.
  - Intervals not to exceed two fuel cycles

EPRI SG Examination Guidelines (Continued)

- NDE technique qualification
- NDE personnel qualification
- Site-specific qualification
- NDE process controls

EPRI SG Tube Integrity Assessment Guidelines

Tube integrity assessment includes:

- Condition Monitoring
- Operational Assessment
- Degradation Assessment

Guidelines address:

- Performance standards for satisfying performance criteria
- Treatment of uncertainties
- Predictive models and methodologies for burst and accident leakage assessment

EPRI SG Tube In-Situ Pressure Test Guidelines

Supplements tube integrity assessment guidelines for condition monitoring.

Addresses:

- Equipment
- Procedure
- Tube selection/screening criteria

Discussion - EPRI Guideline Documents

- It had not, initially, been the staff's intent to formally review or endorse the sub-tier, detailed EPRI guideline documents.
  - staff expectation that guidelines would be sufficiently well developed to lead to improved tube integrity performance.
  - issues pertaining to the guidelines were issues that existed under the current regulatory framework and, thus, were not unique to the proposed new framework.
  - staff expectation that guidelines would continue to evolve over time in response to identified issues, technology changes, lessons learned from operating experience, and results of industry and NRC studies (e.g., NRC SG mockup and ECT round robin, SG and DPO action plan).

Guideline Issues

- Need for consistent, acceptable performance standards for demonstrating that tube integrity performance criteria are met.
- Need for improved guidance on needed attributes of performance demonstration to quantify NDE system (technique plus personnel) flaw detection and sizing performance (uncertainties).
- Need for improved guidance on consideration of NDE flaw detection and sizing performance in condition monitoring and operational assessments.
- Need for NDE data quality (noise) criteria and improved site specific NDE performance demonstration guidelines.

Guideline Issues - Tube Integrity Assessment (Continued)

- Need for improved guidance on SG tube in-situ pressure testing, with respect to test selection criteria, interpretation and assessment of incomplete burst test results, and the use of in-situ test results for purposes of establishing burst and leakage models.

- Need for guidance for bench marking operational assessment methodologies against actual experience.

- Topical issues; e.g., pressurization rate issue, fractional flaw methodology for inferring undetected indications based on NDE POD performance, applicable performance criteria for tubes with small volumetric flaws (e.g., 0.3-in dia).

Performance Standard Guidelines

NEI 97-06 provides a general performance standard for the conduct of condition monitoring and operational assessment:

> *These assessments shall account for all significant uncertainties so as to provide a conservative assessment relative to the performance criteria. Conservative assumptions should be employed to account for uncertainties not directly treated in the analysis.*

The EPRI SG Integrity Assessment Guidelines define specific criteria:

1. Structural limits are set such that a flaw evaluated to be at the limits satisfies the structural performance criteria with probability of 0.9 evaluated at a 50% confidence level.

2. Probability of burst of one or more tubes (for the population of degraded tubes) < 0.1 at applicable performance criteria.

Issue - Performance Standard Guidelines

- Criterion 2 is not applied consistently throughout the guidelines, nor are licensees applying this criteria in many of their tube integrity assessments.

- The staff is concerned that without implementation of criterion 2, there may be relatively low probability that all tube satisfy the performance criteria even though each tube has high probability of satisfying the performance criteria.

Draft Revision 6 to Examination Guidelines
Inspection Intervals

At the NRC SG Workshop in February 2001, industry representatives discussed draft revision 6 to the EPRI SG examination guidelines to permit inspection intervals for SGs with Alloy 600 TT or Alloy 690 TT tubing well beyond current (i.e., Rev. 5) EPRI SG examination guidelines and regulatory requirements:

- Proposed prescriptive criteria
  - For SGs with Alloy 600 TT tubing and no "active degradation," Inspect 50% sample each 5-6 EFPY. (Two fuel cycle limitation has recently been added to draft.)
  - For SGs with Alloy 690 TT tubing and no "active degradation," Inspect 50% sample each 6-7 EFPY. (Three fuel cycle limitation has recently been added to draft.)

Draft Revision 6 to Examination Guidelines
Inspection Intervals (Continued)

- Proposed prescriptive criteria (Cont)
  - (One cycle limitation for alloy 600 MA tubing was recently added to draft.)
  - In addition, planned inspection intervals must be supported by operational assessment.
- Proposed performance based criteria
  - Applicable to SGs with Alloy 600 TT and 690 TT
  - As necessary to ensure performance criteria are maintained, as supported by degradation and operational assessment, possibly ranging to 22 EFPY.

Staff Concerns Regarding Extended Inspection Intervals

- Appropriate inspection/condition monitoring intervals are critical to ensuring the prompt detection of conditions not meeting performance criteria.
- Certain guidelines not sufficiently well developed to support inspection intervals significantly longer than what is being implemented under current requirements or acceptable alternatives.
- Industry may revise guidelines; licensees may not follow aspects of the guidelines.
- Assurance needed that condition monitoring will be capable of fulfilling its 10 CFR 50, Appendix B obligation.

Guideline Issues - Inspection Intervals

- Numerous issues relating to the rigor of guidelines for tube integrity assessments (condition monitoring and operational assessment); particularly the treatment of uncertainties associated with these assessments. Longer inspection intervals magnify the importance of these uncertainties relative to ensuring that the performance criteria are being maintained.

- Guidelines for operational assessment of active degradation mechanisms are not yet sufficiently developed to be used as tool for directly determining acceptable inspection interval extensions.

- Degradation assessment guideline details, and technical bases for these guidelines, have not been developed for ensuring that the initial occurrence of new degradation mechanisms will not cause performance criteria to be exceeded.

- Draft inspection interval strategies for Rev 6 of examination guidelines are still being finalized, have thus far lacked critical details, and technical justification has not been provided.

Resolution Path Proposed by NRC Staff

- Predictive methodologies for managing known degradation mechanisms and anticipating the occurrence of new mechanisms need to be strengthened to support implementation of inspection intervals significantly exceeding current requirements or acceptable alternative.
  - The staff will continue to work with the industry in identifying the needed improvements to the guidelines.
- In meantime, inspection intervals should be subject to appropriate limitations, based on experience and consideration of the improved stress corrosion performance expected with alloy 600 TT and 690 TT tubing. Acceptable approaches include:
  - limitations similar to current specs
  - potential others; e.g., prescriptive approach being developed for Rev 6 of guidelines subject to resolution of staff comments

Resolution Path Proposed by NRC Staff (Continued)

- In addition to the need for acceptable inspection interval criteria, the staff has concluded that there must be appropriate regulatory controls with respect to inspection intervals to ensure that the performance criteria are maintained, that conditions failing to satisfy these criteria are promptly detected and corrected, and that risk is not increased.

Resolution Path Proposed by NRC Staff (Continued)

Industry proposed Admin TS would be revised to include the following:

> *SG Inspection Interval - Inspection intervals for SG tubing shall not exceed the maximum intervals defined in the SG Program. Revisions to these maximum inspection intervals require review and approval by the NRC staff. The maximum intervals may be revised to incorporated changes approved generically by the NRC subject to the limitations set forth in the staff's approving document.*

Licensees would submit the maximum intervals which will initially be in their SG Programs when they submit their plant-specific change packages. The staff would review and approve.

Industry Response

NEI/NRC public meeting dated November 1, 2001

- NRC comments on inspection interval issue are being addressed.
- New draft of rev 6 issued for industry comment on 10/22/01. Comments requested by 12/18/01.
- Following this review, revised draft to be provided to NRC.

NEI letter dated November 2, 2001

- Proposed control on inspection intervals through the licensee commitment process in lieu of admin TS control.

NRC Status - Letter to NEI dated November 26, 2001

- Industry's November 2 proposal does not adequately address the staff's concerns.
- The staff remains committed to a revised regulatory framework which is more directly focused on ensuring tube integrity and which will result in enhanced flexibility to licensees.
- No further progress can be made until inspection interval issue is resolved.
- NEI should submit appropriate inspection interval criteria and a revised administrative technical specification proposal which ensures that these criteria will be implemented unless otherwise reviewed and approved by the NRC staff.
  - Request target date of 1/31/2002.
- Unless timely resolution can be reached, staff may consider alternative approaches to achieving revised regulatory framework.

Industry Response - Proposed Resolution

NRC/NEI Senior Management Meeting - Nov. 28, 2001:

- Industry can accept the concept of an administrative TS similar to that proposed by NRC staff controlling changes in inspection intervals with interval lengths defined outside of TS. (Staff proposal should be revised to clarify that the generic approval process for changes to maximum inspection intervals may involve approval of methodologies for determining maximum inspection intervals.)

- But only if the technical issues surrounding extended intervals are resolved first.

  - i.e., resolution of issues pertaining to inspection interval criteria to be incorporated in Rev 6 of the SG examination guidelines

Industry Response - Proposed Schedule

- Disposition industry and NRC comments on Rev 6 of examination guidelines - early 2002.
- Reach agreement with NRC on extended inspection intervals - mid 2002.
- Submit final GLCP reflecting inspection intervals - mid 2002.
- Issue SG Examination Guidelines, Revision 6 - mid 2002.
- NRC approval of GLCP - late 2002.
- Submittal of plant-specific license amendments - 2003.
- Implementation - 2003.

Conclusions

- There is conceptual agreement on a resolution path for the inspection interval issue, allowing review of the GLCP to proceed.
- Staff will work with NEI to achieve best possible schedule.
- Industry needs to finalize the technical details of the Rev 6 inspection interval criteria and address staff comments thereto.
- Over the long term, the staff and industry need to work together to identify the needed changes to industry guidelines which will allow optimal flexibility to licensees in implementing their SG programs consistent with continued maintenance of SG tube integrity.